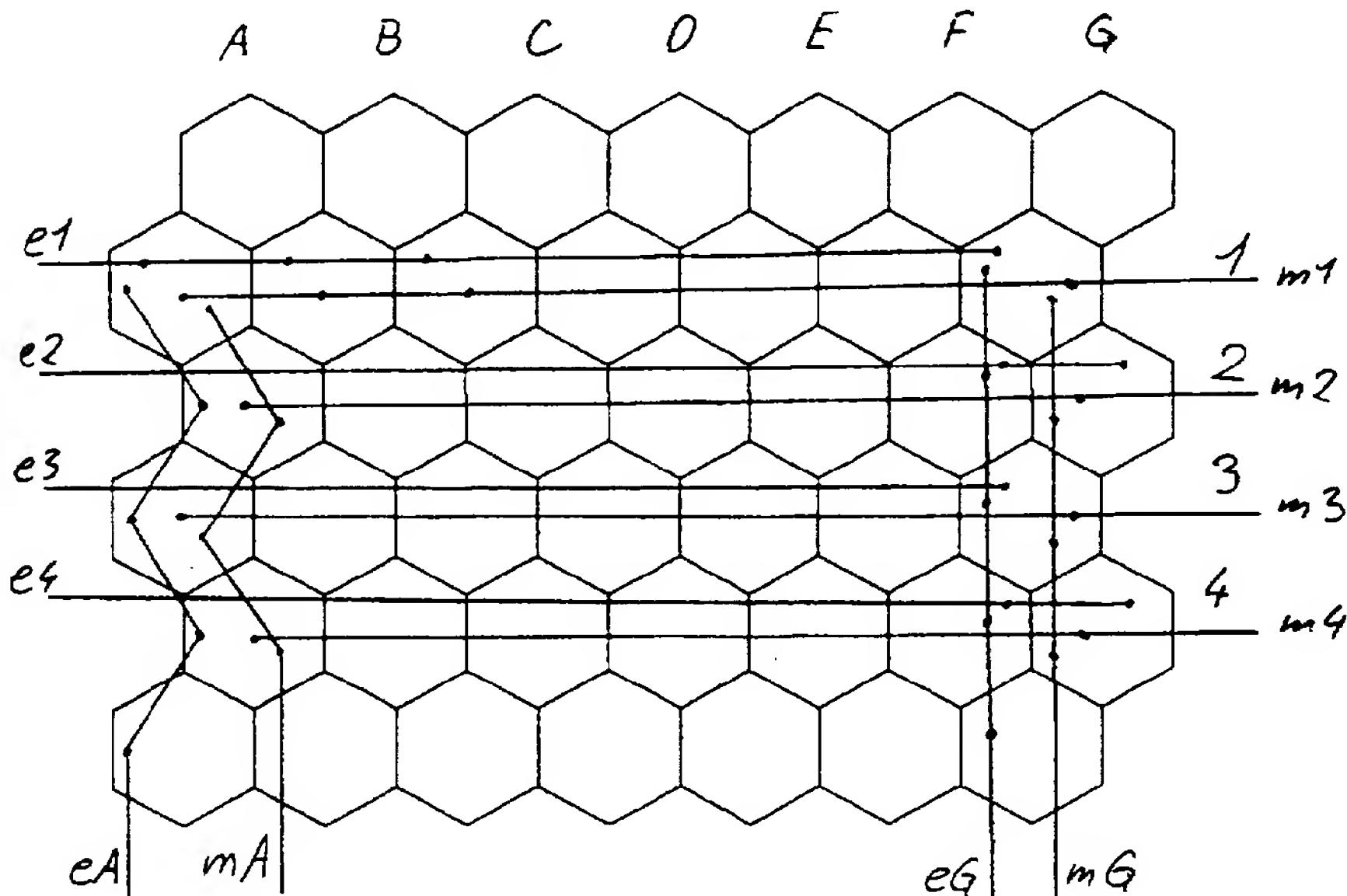




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## (54) Title: A COOKING SURFACE WITH CONTROLS



## (57) Abstract

A cooking surface consists of a large number of cells arranged in an array. The cells are energized according to the thermal load on them so that cells not covered by a cooking utensil are not energized. The control performs clustering of heat load data and calculates the average thermal load. A cooking utensil may be freely moved about on the surface and the heating it requires will be supplied at any placing. The cells may provide the energy in the form of radiant heating or as energy from induction coils in each cell.

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## A cooking surface with controls

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The invention relates to a cooking surface comprising sources of energy and monitoring devices for the thermal load on the surface which control the power supply during use and which switch off the power in the 5 case of no load being present.

Present-day cooking surfaces generally consist of between one and five hot zones which are distributed below a tough and heat resistant top surface with no specific delimitations other than markings. A hot zone 10 fitting to the size of the cooking utensil is selected and energized, and the cooking proceeds, possibly controlled automatically, either by temperature sensors directly influenced by the contents or by sensors for the thermal load comprised by the cooking utensil and 15 the food to be cooked. Such sensors at least have the ability to switch off the power in case there is no load in order that overheating of the cooking utensil or a potentially dangerous situation with a very hot surface is avoided.

20 In early days, a hot top surface for cooking in e.g. restaurants had no delimitation of cooking zones, but the front part (the part nearest to the user) was the hottest, and the rear part was considered the "back burner" and sliding from the front to the back permitted 25 bringing the food to its desired temperature at the front and letting it continue the cooking at the rear.

In order to obtain a similar function in a modern guise, i.e. a continuous passage from the hotter front to the relatively cooler back of a cooking surface, DE 30 40 07 680 describes how a number of hot zones are fitted in matrix fashion in conjunction with a vitroceramic cooking surface in order that the cooking utensil may be slid along the surface towards the back when a lower temperature is needed. Sensors connected to the hot 35 zones only switch on those hot zones which are covered by the cooking utensil at any one instant. The described construction aims at avoiding the use of switches or

other user activated controls since switching-on is automatic and the temperature is dependent on the placement of the cooking utensil.

While the above construction gives a good simulation of the temperature distribution in early days without the constant power consumption and heat loss, there is perceived a need for a cooking surface which will service a number of cooking utensils simultaneously and at the same time to provide individual power supply in dependence of the food to be cooked while still ensuring full protection against overheating. This need is not addressed by the described German publication DE 40 07 680.

A construction which addresses this need is particular in that the number of sources of energy is large, with a minimum of 5 sources, preferably a minimum of 20 sources, per cooking utensil to be serviced, and that each source is only energized when its thermal load is determined as sufficient. In this manner, a cooking utensil may be moved to any place on the cooking surface to make room for other cooking utensils and still retain the cooking desired. One standard size cooking utensil has a diameter of 15 cm, and the number range specified allows proper regulation of the energy supply to each cooking utensil. The supply of a large number of very small sources of energy ensures an even heating of both small and large cooking utensils and enables the heating of square or rectangular cooking utensils which until now have not been heatable in a relevant manner, except by putting them in an oven. The determination of thermal load may be performed using devices according to international applications PCT/DK94/00456 and PCT/DK94/00457, to which reference is specifically made. Alternatively, an array of infrared sensors may be used.

In a preferred embodiment of the invention the arrangement of the sources of energy is in a matrix fashion. This means that power supply to each source may

occur via columns and rows which reduces the number of switching elements needed to be the sum of columns and rows rather than equal to the total number of sources of heat.

5 In another embodiment the sources of energy are arranged with a minimum of non-heating surface between them. This corresponds to having the maximum of sources of energy within a circular perimeter of a cooking utensil. In this case, the wiring will reflect that such 10 a configuration is in reality only a distortion of a matrix arrangement as above described.

In a preferred embodiment the determination of thermal load occurs in conjunction with each source of energy. In this way, not only is each source of energy 15 only energized when needed, but the precision is enhanced.

In a further preferred embodiment each point of determination of thermal load communicates with a central control unit which performs clustering of heat 20 load data and calculation of an average heat load by cooking utensils, in order to control the energy supply to the individual sources of energy. This embodiment makes use of image recognition methods which are easily implemented in data processing chips. The information 25 that a thermal load is sufficient from a number of thermal load sensors allows clustering into contiguous areas which constitute an image of the instantaneous distribution of cooking utensils on the cooking surface.

Due to surface irregularities which may appear in 30 some cooking utensil bottoms a higher precision in thermal load determination may be obtained by averaging the individual determinations in a single cluster, and hence it may be avoided that an individual source of heat is switched off due to a local lack of thermal 35 load, although sources of heat immediately surrounding it are still switched on.

In a further embodiment the sources of heat are

constituted by halogen bulbs which are individually energized according to the scheme relevant to this construction. Among other advantages accruing from this construction is the low thermal capacity of each heat 5 source and its immediate surroundings, enabling a faster reaction to a cooling requirement similar to the desirable qualities of e.g. gas heating.

In a further advantageous embodiment the heat is generated in the cooking utensil by induction coils 10 which are individually energized in the manner of induction hotplates according to the scheme relevant to this construction. Thereby the top surface temperatures may be held at a still lower value which is a distinct 15 advantage in the present environment comprising a large number of electronic switches.

The invention will be described in greater detail in the following with reference to the drawing, in which

Fig. 1 shows part of the top of a cooker in which the distribution of a large number of heat sources with 20 thermal load sensors is indicated,

Fig. 2 shows the perimeter of a cooking utensil covering a number of energy sources with thermal load sensors, as well as lines for communication and energy supply, and

25 Fig. 3 shows a block diagram of the interconnections between the large number of heat sources with thermal load sensors and a control unit.

In Fig. 1 is shown a grid which represents part of the top of a cooker according to the invention. The grid 30 defines cells by means of row indications (1, 2, 3, 4) and column indications (A, B, C, ..., K), it being understood that this section of 44 cells is only a part of the total surface of a cooker in which each cell may be defined by coordinates, such as 1b or 4j. These are 35 indicated by hatching. Each cell has provisions for energy supply and provisions for measuring the thermal load of the cell, such as a probe to which a connection

may be established.

The cells are supplied with electrical energy by means of a grid of wires (e1, e2, e3, e4) and (eA, eB, eC, ..., eK) respectively. These wires are in turn 5 connected to main supply wires Wr and Wc by in such a manner that only those cells which are simultaneously connected to both horizontal Wr and vertical Wc main supplies are acting as energy sources in the top of the cooker. The selection of grid wires occurs through 10 electronic switches in each wire (se1, se2, se3, se4) and (seA, seB, seC, ..., seK). These switches are controlled by a main controller CC for the cooktop.

In a similar fashion, each cell is connected to a grid of sense wires (m1, m2, m3, m4) and (mA, mB, mC, 15 ... mK) respectively which lead to two data buses Mr and Mc via strobing switches (sm1, sm2, sm3, sm4) and (smA, smB, smC, ..., smK). By means of cyclic strobing, each cell is addressed in turn, and the controller obtains 20 information on the thermal load status of each cell.

20 In Fig. 2 is shown part of a cooktop with a different tessellation. Each cell 1A through 4G is hexagonal which permits a closer approximation to a circular bottom of a cooking vessel. Although a larger number of rows and a smaller number of columns is shown 25 than in Fig. 1, the designation of the cells has been retained. It will be recognized that the addressing of energy sources and of sensors is identical to the rectangular type grid, although the column grid wires may take two different courses as shown at eA, mA and 30 eG, mG respectively.

35 In Fig. 3 is shown a block diagram of the interconnection between the supply and feedback systems and the power supply unit and control unit respectively. According to one embodiment of the invention a primitive image processing system is involved in that information on clusters of similarly indicating sensors at any one time permits an outline of a thermal load area to be

defined. The cooking vessel is regarded as being positioned within this outline, and the power supplied to each cell is equalized. Alternatively, a subcluster of cells representing a low load area within the outline 5 may be supplied with a higher level of energy in order to decrease the cooking time, letting the standard reading from the majority of cells within the outline determine if an increasing low load situation, designating dry cooking or removal of a cooking vessel 10 is occurring.

In one embodiment of the invention, a cooking surface is supplied with a vast number of halogen bulbs with individual reflectors supported by a perforated plate, one hole for each bulb.

## P A T E N T C L A I M S

1. A cooking surface comprising sources of energy and monitoring devices for the thermal load on the 5 surface which control the power supply during use and which switch off the power in the case of no load being present, characterised in that the number of sources of energy is large, with a minimum of 5 sources, preferably a minimum of 20 sources, per 10 cooking utensil to be serviced, and that each source is only energized when its thermal load is determined as sufficient.

2. A cooking surface according to claim 1, characterised in that the sources of 15 energy are arranged in a matrix fashion.

3. A cooking surface according to claim 2, characterised in that the sources of energy are arranged with a minimum of non-heated surface between them.

20 4. A cooking surface according to any of the preceding claims, characterised in that the determination of thermal load occurs in conjunction with each source of energy.

25 5. A cooking surface according to claim 4, characterised in that each point of determination of thermal load communicates with a central control unit which performs clustering of heat load data and calculation of an average heat load by cooking utensils, in order to control the energy supply 30 to the individual sources of energy.

35 6. A cooking surface according to any of the above claims, characterised in that the sources of energy are constituted by halogen bulbs which are individually energized according to the scheme relevant to this construction.

7. A cooking surface according to any of the above claims, characterised in that the heat is generated in the cooking utensil by induction coils which are individually energized in the 5 manner of induction hotplates according to the scheme relevant to this construction.

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Fig. 1.

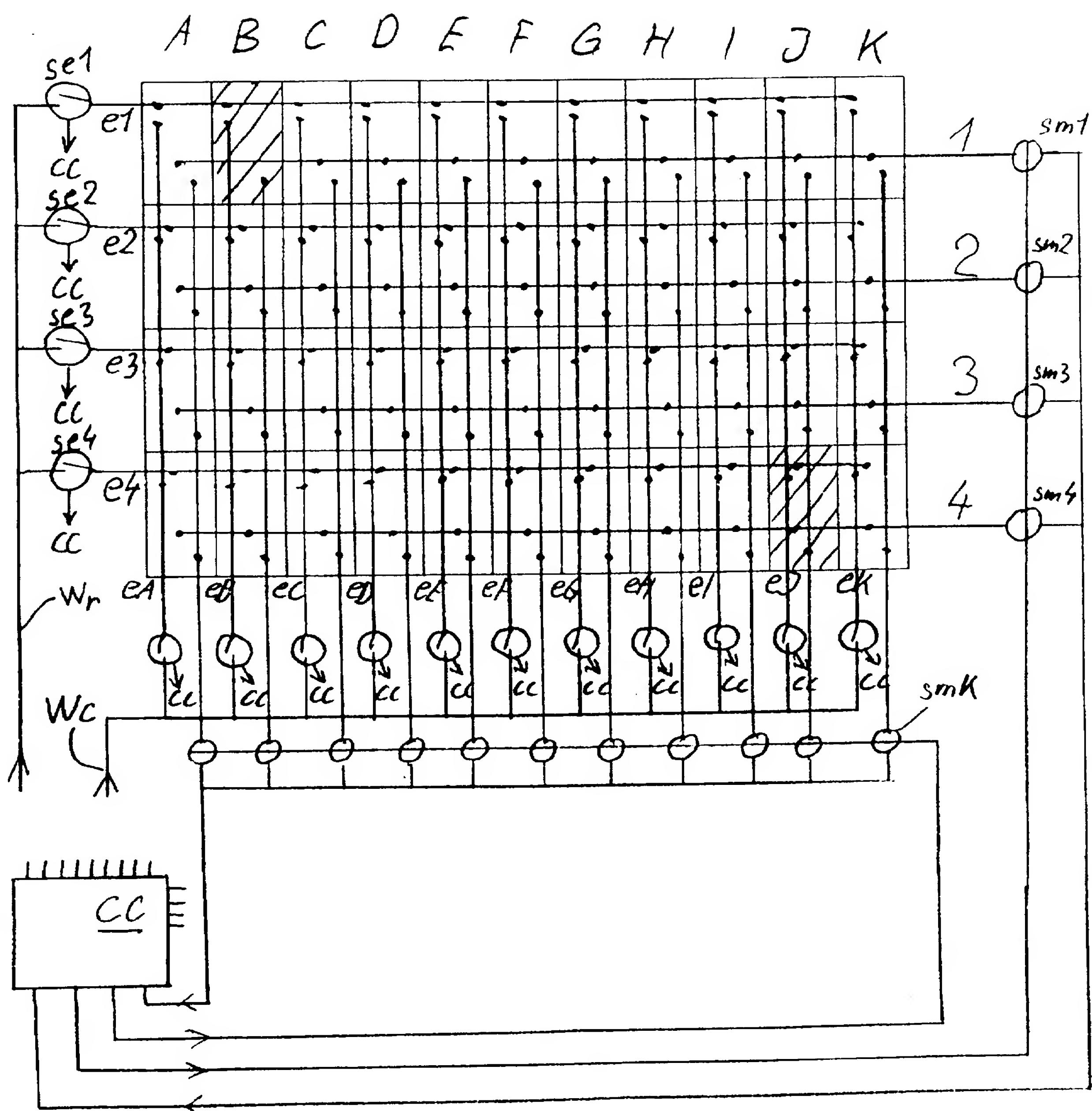


Fig. 2

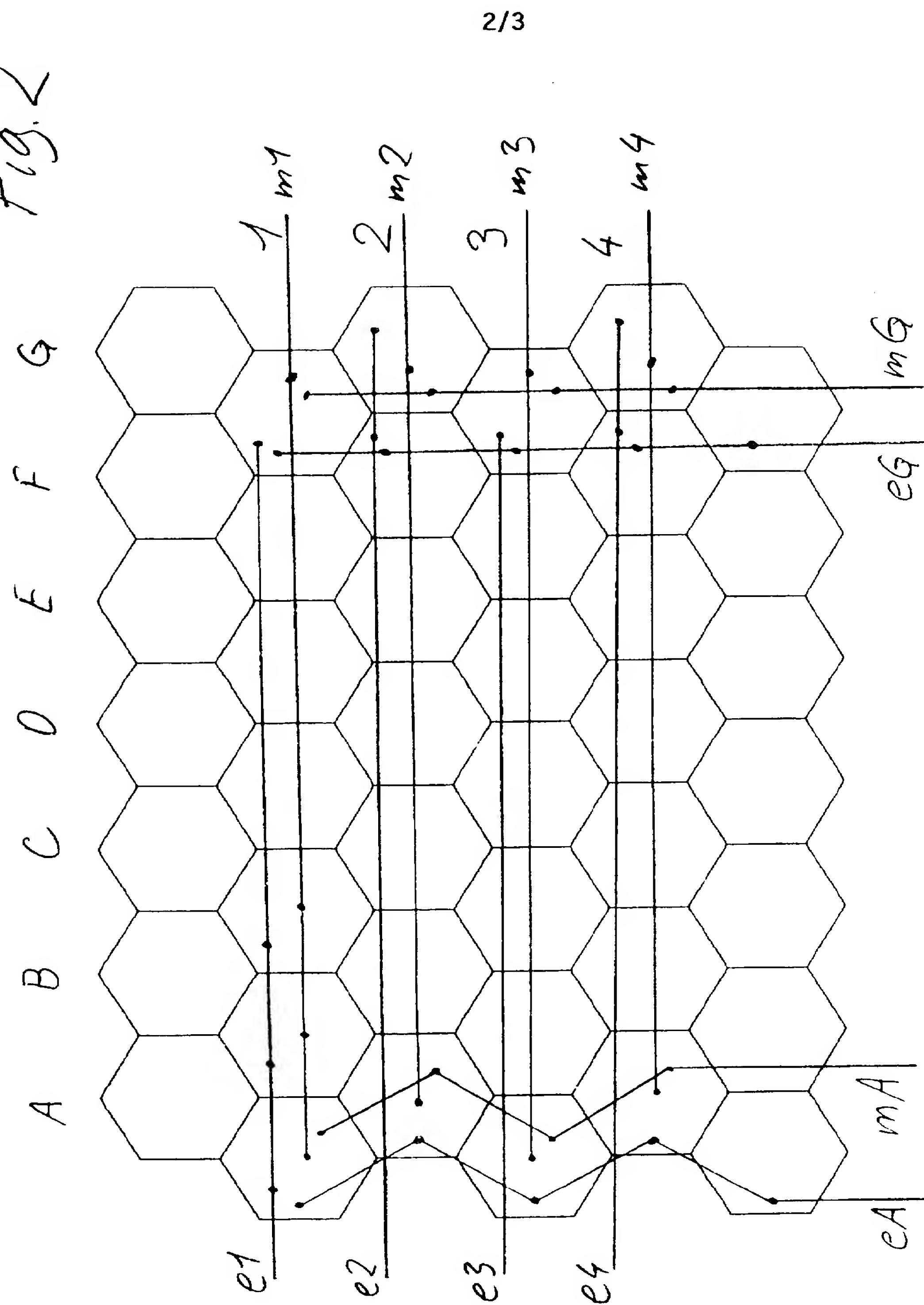
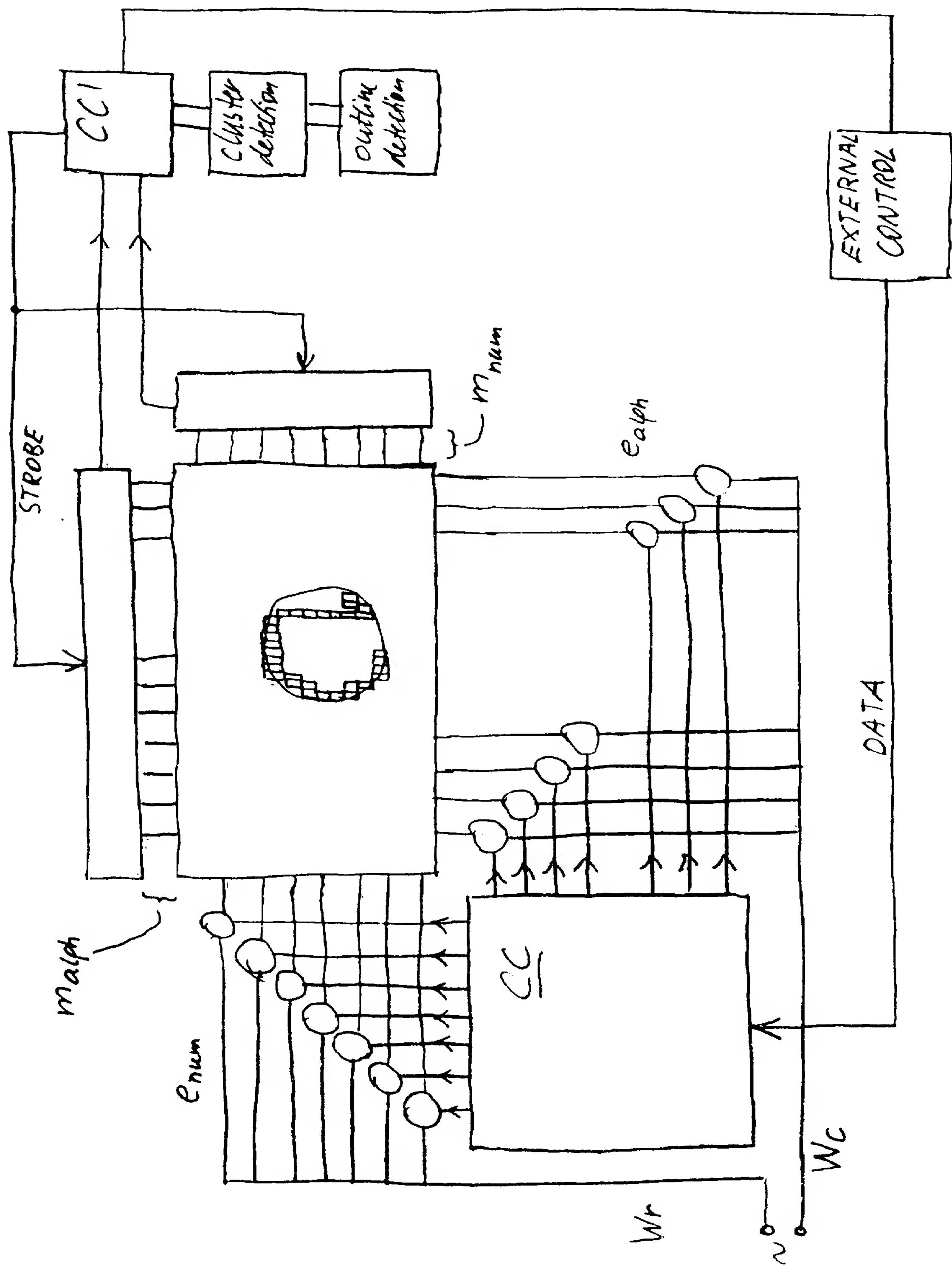


Fig. 3



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 96/00479

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F24C 7/08, H05B 3/68

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F24C, H05B, G05D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5243171 A (WOOD ET AL), 7 Sept 1993 (07.09.93)	1-5, 7
Y	--	6
X	US 3215817 A (D.C. PEEK), 2 November 1965 (02.11.65), column 2, line 25 - line 30, figure 6	1, 4
Y	GB 2154405 A (THORN EMI DOMESTIC APPLIANCES LIMITED ET AL), 14 Sept 1985 (14.09.85), figure 12, abstract	6
A	US 3953711 A (ECK ET AL), 27 April 1976 (27.04.76), figure 1, abstract	1-7
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 Further documents are listed in the continuation of Box C. See patent family annex.

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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WO 9516334 A1	15/06/95	AU 1064295 A EP 0740895 A		27/06/95 06/11/96
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